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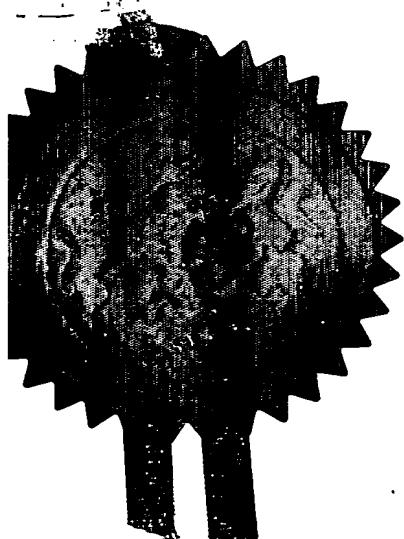
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1/77

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C8121485003

Patents ADP number (if you know it)

CELLTECH R&D LIMITED
208 BATH ROAD
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If the applicant is a corporate body, give the country/state of its incorporation

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4. Title of the invention

BIOLOGICAL PRODUCTS

5. Name of your agent (if you have one)

THOMPSON, JOHN

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BIOLOGICAL PRODUCTS

The present invention relates generally to methods of treating multiple sclerosis and more specifically to the use of inhibitors of IL-17 activity for the manufacture of a medicament for the treatment of multiple sclerosis.

Interleukin 17 (IL-17), also known as CTLA-8 or IL-17A, is a pro-inflammatory cytokine which stimulates the secretion of a wide range of other cytokines from various non-immune cells. IL-17 is capable of inducing the secretion of IL-6, IL-8, PGE2, MCP-1 and G-CSF by adherent cells like fibroblasts, keratinocytes, epithelial and endothelial cells and is also able to induce ICAM-1 surface expression, proliferation of T cells, and growth and differentiation of CD34+ human progenitors into neutrophils when cocultured in presence of irradiated fibroblasts (Fossiez *et al.*, 1998, Int.Rev.Immunol. 16, 541-551). IL-17 is predominantly produced by activated memory T cells and acts by binding to a ubiquitously distributed cell surface receptor (IL-17R) (Yao *et al.*, 1997, Cytokine, 9, 794-800). A number of homologues of IL-17 have been identified which have both similar and distinct roles in regulating inflammatory responses. For a review of IL-17 cytokine/receptor families see Dumont, 2003, Expert Opin. Ther. Patents, 13, 287-303.

IL-17 may contribute to a number of diseases mediated by abnormal immune responses, such as rheumatoid arthritis and air-way inflammation, as well as organ transplant rejection and antitumour immunity. Inhibitors of IL-17 activity are well known in the art, for example an IL-17R:Fc fusion protein was used to demonstrate the role of IL-17 in collagen-induced arthritis (Lubberts *et al.*, J.Immunol. 2001, 167, 1004-1013) and neutralising polyclonal antibodies have been used to reduce peritoneal adhesion formation (Chung *et al.*, 2002, J.Exp.Med., 195, 1471-1478). Neutralising monoclonal antibodies are commercially available (R&D Systems UK).

Multiple sclerosis (MS) is a chronic, inflammatory, demyelinating disease of the central nervous system (CNS), which is believed to result from a coordinated autoimmune attack against myelin antigens. There is considerable clinical and pathological heterogeneity in MS patients and the sequence of events that initiate the disease remain largely unknown. The clinical progression of MS may be largely attributed to three disease processes; inflammation, demyelination and axonal loss / neurodegeneration.

Immune mediated inflammatory lesions within the CNS are thought to result primarily from an infiltration of autoreactive CD4⁺ lymphocytes (Th1) which recognise

myelin proteins presented on MHC class II molecules by antigen presenting cells. This interaction causes stimulation of Th1 cells which release proinflammatory cytokines (mainly TNF- α & IFN- γ) resulting in proliferation of T-cells, activation of B-cells and macrophages, upregulation of adhesion molecules and disruption of the blood-brain barrier. Such events ultimately lead to loss of oligodendrocytes & axons and the formation of a demyelinated plaque. This is the hallmark of MS and consists of a demarcated lesion where myelin sheaths are completely lost and demyelinated axons are embedded in glial scar tissue. Demyelination may also occur as a consequence of specific recognition and opsonization of myelin antigens by autoantibodies. The most important target antigen is suggested to be myelin oligodendrocyte protein (MOG), which is present on the surface of the myelin sheath. Destruction of antibody-opsonized myelin is then accomplished either by complement or activated macrophages. Axonal loss and neurodegeneration subsequent to inflammation are thought to be responsible for the accumulation of irreversible neurological impairment, characteristic of secondary progressive MS.

The clinical features of MS vary from headaches and blurred vision to severe ataxia, blindness and paralysis. MS affects all ages but first symptoms generally occur between 18 and 50 years and disease duration has been estimated at >25 years with a significant proportion of patients dying from causes unrelated to MS. In the majority of patients (~80%) the disease takes a relapsing-remitting (RR-MS) course with exacerbation of symptoms, which is rapid in onset (hours to days) followed by a slower recovery. The frequency and duration of relapses are unpredictable but average 1.5 per year and can be followed by complete recovery. With time, recovery from relapses may not be complete and a gradual worsening of disease occurs. This worsening of disease is independent of relapse rate and is classified as secondary progressive MS (SP-MS), accounting for approximately 10% of MS patients. The remaining 10% of MS patients have a primary progressive (PP-MS) course where disability worsens at a steady rate from onset of the disease.

Currently licensed therapies are the beta-interferons; Interferon beta-1b (*Betaseron*; Berlex), Interferon beta-1a (*Avonex*; Biogen, *Rebif*; Serono) and glatimer acetate (*Copaxone*; Teva). These agents have been shown to reduce relapse rate during the relapsing-remitting phase of the disease in approximately 30% of patients. There is currently no method available for identifying the responder population before therapy. Intravenous steroids (prednisolone is most commonly used) are used to hasten remission after relapse but do not have long term efficacy. The anti-cancer agent, mitoxantrone (*Novantrone*), is approved as

an immunosuppressant in progressive-relapsing and secondary-progressive patients, but its use and dose is limited by cardiotoxicity. In Europe azathioprine has also been used as an immunosuppressant.

Prescribing decisions seem to be driven by evidence-based medicine and a recent report by the American Association of Neurologists (Goodin DS et al; Neurology 2002 Jan 22;58(2):169-78) is a key document. The consensus amongst many neurologists is that early, aggressive therapy with beta-interferons was desirable in increasing the time to first relapse and limiting the overall disease load, although it was recognised that there was no evidence that this approach showed long-term benefit on EDSS score (a measure of disease-related disability). Beta-interferons were seen as sub-optimal therapy and glatiramer acetate as having a different mechanism of action, which may allow it to be used (alone or in combination) in patients that do not respond to interferons. Individualised therapy based on mechanistic (MRI, genetic, neurological) markers of disease was seen as a worthwhile goal, as were therapies with a novel mechanism of action. There is currently no satisfactory diagnostic marker for multiple sclerosis.

There is a clear need for disease modifying therapies. Agents with different mechanisms of action are needed and may allow therapy to be tailored to different stages of the disease. An orally active agent is yet to be licensed in the relapsing-remitting form of the disease and this would represent a clear improvement over current therapy if significant efficacy was associated with the mechanism. Furthermore, there is a clear requirement for therapies that show efficacy in the primary or secondary progressive phases of the disease and have a reasonable side-effect profile.

Whether IL-17 plays any kind of role in the pathogenesis of MS is unknown. Microarray analysis of MS lesions obtained at autopsy have revealed increased transcripts of many different genes encoding inflammatory cytokines, including, IL-17 (Lock *et al.*, 2002, Nature Medicine, 8, 500-508). An ~~increased~~ number of IL-17 expressing mononuclear cells have been detected in blood and cerebrospinal fluid from patients with MS (Matusevisius *et al.*, 1999, Multiple Sclerosis, 5, 101-104) but as the authors point out cytokine mRNA expression is not necessarily identical to cytokine protein production.

Surprisingly we have been able to demonstrate that inhibitors of IL-17 activity are active in an animal model of MS. Specifically we have been able to demonstrate that an anti-IL-17 antibody that inhibits IL-17 activity is active in an animal model of MS. Hence, the present invention provides a method for the treatment of MS comprising administering a

therapeutically effective amount of an inhibitor of IL-17 activity. The invention also provides the use of an inhibitor of IL-17 activity for the manufacture of a medicament for the treatment of multiple sclerosis.

The term 'IL-17 activity' as used herein refers to the spectrum of activity understood in the art for IL-17 for example, the induction of secretion of IL-6 or IL-8 from fibroblasts by IL-17 (Yao *et al.*, 1995, *Journal of Immunology*, 155,5483-5486).

An inhibitor of IL-17 activity according to the present invention is an agent that interferes with the activity of IL-17, in particular the activity of IL-17 in MS. Inhibitors according to the present invention may partially or completely inhibit IL-17 activity.

Inhibitors of use in the present invention include without limitation, inhibitors that are capable of interacting with (*e.g.* binding to, or recognising) IL-17 or the IL-17 receptor (IL-17 R) or a nucleic acid molecule encoding IL-17 or IL-17R, or are capable of inhibiting the expression of IL-17 or IL-17 R or are capable of inhibiting the interaction between IL-17 and IL-17R. Such inhibitors may be, without limitation, antibodies, nucleic acids (*e.g.* DNA, RNA, antisense RNA and siRNA), carbohydrates, lipids, proteins, polypeptides, peptides, peptidomimetics, small molecules and other drugs.

Examples of suitable inhibitors include, but are not limited to, a synthetic functional fragment of the IL-17 receptor that binds to IL-17 and interferes with binding to the native IL-17 receptor, an antibody that binds to IL-17 or to the IL-17 receptor and interferes with IL-17 receptor-ligand interaction, an antisense nucleic acid molecule that specifically hybridizes to mRNA encoding IL-17 or the IL-17 receptor or a small molecule or other drug which inhibits the activity of IL-17 or its receptor.

Inhibitors of IL-17 activity are well known in the art as are methods of identifying and producing such inhibitors. Examples include, IL-17R:Fc fusion proteins (Lubberts *et al.*, *J.Immunol.* 2001,167, 1004-1013) and neutralising antibodies (Chung *et al.*, 2002, *J.Exp.Med.*, 195, 1471-1478; Ferretti, 2003, *Journal of Immunology*, 170, 2106-2112). Agents that may be suitable inhibitors can be selected from a wide variety of candidate agents. Examples of candidate agents include but are not limited to, nucleic acids (*e.g.* DNA and RNA), carbohydrates, lipids, proteins, polypeptides, peptides, peptidomimetics, small molecules and other drugs. Agents can be obtained using any of the numerous approaches in combinatorial library methods known in the art, including: biological libraries; spatially addressable parallel solid phase or solution phase libraries; synthetic library methods requiring deconvolution; the "one-bead one-compound" library method; and synthetic library

methods using affinity chromatography selection. The biological library approach is suited to peptide libraries, while the other four approaches are applicable to peptide, non-peptide oligomer or small molecule libraries of compounds (Lam, 1997, *Anticancer Drug Des.* 12:145; U.S. 5,738,996; and U.S. 5,807,683).

5 Examples of suitable methods based on the present description for the synthesis of molecular libraries can be found in the art, for example in: DeWitt *et al.*, 1993, Proc. Natl. Acad. Sci. USA 90:6909; Erb *et al.*, 1994, Proc. Natl. Acad. Sci. USA 91:11422; Zuckermann *et al.*, 1994, J. Med. Chem. 37:2678; Cho *et al.*, 1993, Science 261:1303; Carrell *et al.*, 1994, Angew. Chem. Int. Ed. Engl. 33:2059; Carell *et al.*, 1994, Angew. 10 Chem. Int. Ed. Engl. 33:2061; and Gallop *et al.*, 1994, J. Med. Chem. 37:1233.

Libraries of compounds may be presented, for example, in solution (e.g. Houghten, 1992, Bio/Techniques 13:412-421), or on beads (Lam, 1991, Nature 354:82-84), chips (Fodor, 1993, Nature 364:555-556), bacteria (US 5,223,409), spores (US 5,571,698; 5,403,484; and 5,223,409), plasmids (Cull *et al.*, 1992, Proc. Natl. Acad. Sci. USA 89:1865-1869) or phage (Scott and Smith, 1990, Science 249:386-390; Devlin, 1990, Science 15 249:404-406; Cwirla *et al.*, 1990, Proc. Natl. Acad. Sci. USA 87:6378-6382; and Felici, 1991, J. Mol. Biol. 222:301-310).

In one example, the inhibitor for use in the present invention may be a nucleic acid. In particular IL-17 or IL-17R nucleic acid molecules may be used as anti-sense molecules, to alter the expression of their respective polypeptides by binding to complementary nucleic acids. IL-17 or IL-17R nucleic acids may be obtained using standard cloning techniques from for example genomic DNA or cDNA or can be synthesised using well known and commercially available techniques. The IL-17 or IL-17R nucleic acids may contain one or more nucleotide substitutions, additions or deletions into the nucleotide sequence of an IL-17 or 20 IL-17R nucleic acid. Standard techniques known to those of skill in the art can be used to introduce mutations, including, for example, site-directed mutagenesis and PCR-mediated mutagenesis. An antisense nucleic acid according to the present invention includes a IL-17 or 25 IL-17R nucleic acid capable of hybridising by virtue of some sequence complementarity to a portion of an RNA (preferably mRNA) encoding the respective polypeptide. The antisense nucleic acid can be complementary to a coding and/or non-coding region of an 30 mRNA encoding such a polypeptide. Most preferably, the antisense nucleic acids result in inhibition of the expression of the IL-17 or IL-17R polypeptide. Thus, the present invention provides a method for the treatment of MS comprising administering a therapeutically

effective amount of an inhibitor of IL-17 activity wherein the inhibitor comprises at least eight nucleotides that are antisense to a gene or cDNA encoding a IL-17 or IL-17R polypeptide. The invention also provides the use of nucleic acids comprising at least eight nucleotides that are antisense to a gene or cDNA encoding a IL-17 or IL-17R polypeptide for the manufacture of a medicament for the treatment and/or prophylaxis of MS.

5 Most preferably, an inhibitor for use in the treatment and/or prophylaxis of MS is an antibody that interacts with (*i.e.* binds to or recognises) IL-17 or its receptor and inhibits the activity of IL-17. Accordingly, there is provided the use of an antibody that inhibits the activity of IL-17 for the manufacture of a medicament for the treatment and/or prophylaxis 10 of MS. Also provided is a method of treatment and/or prophylaxis of MS in a subject comprising administering to said subject a therapeutically effective amount of an antibody that inhibits the activity of IL-17.

In one example the antibodies selectively interact with IL-17. Selectively interacting with (*e.g.* recognising or binding to) means that the antibodies have a greater affinity for IL-15 17 polypeptides than for other polypeptides. Examples of suitable antibodies are those that inhibit the activity of IL-17 by binding to IL-17 in such a manner as to prevent it being biologically active, for example by preventing the binding of IL-17 to its receptor. Accordingly, there is provided by the present invention the use of an anti-IL-17 antibody for the manufacture of a medicament for use in the treatment and/or prophylaxis of MS.

20 In another example the antibodies selectively interact with the IL-17 receptor. Selectively interacting with (*e.g.* recognising or binding to) means that the antibodies have a greater affinity for the IL-17 receptor polypeptide than for other polypeptides. Examples of suitable antibodies are those that inhibit the activity of IL-17 by preventing IL-17 mediated signalling from the receptor, for example by preventing IL-17 from binding to the IL-17 25 receptor. Accordingly, there is provided by the present invention the use of an anti-IL-17R antibody for the manufacture of a medicament for use in the treatment and/or prophylaxis of MS.

IL-17 or IL-17 receptor polypeptides or cells expressing said polypeptides can be used to produce antibodies which specifically recognise said polypeptides. The IL-17 and 30 IL-17 R polypeptides may be 'mature' polypeptides or biologically active fragments or derivatives thereof. IL-17 and IL-17 R polypeptides may be prepared by processes well known in the art from genetically engineered host cells comprising expression systems or they may be recovered from natural biological sources. In the present application, the term

“polypeptides” includes peptides, polypeptides and proteins. These are used interchangeably unless otherwise specified. IL-17 or IL-17R polypeptides may in some instances be part of a larger protein such as a fusion protein for example fused to an affinity tag. Antibodies generated against these polypeptides may be obtained by administering the polypeptides to an animal, preferably a non-human animal, using well-known and routine protocols.

5 Anti-IL-17 and anti-IL-17 receptor antibodies for use in the present invention include whole antibodies and functionally active fragments or derivatives thereof and may be, but are not limited to, polyclonal, monoclonal, multi-valent, multi-specific, humanized or chimeric antibodies, single chain antibodies, Fab fragments, Fab' and F(ab')₂ fragments, 10 fragments produced by a Fab expression library, anti-idiotypic (anti-Id) antibodies, and epitope-binding fragments of any of the above.

15 Antibodies include immunoglobulin molecules and immunologically active portions of immunoglobulin molecules, *i.e.* molecules that contain an antigen binding site that specifically binds an antigen. The immunoglobulin molecules of the invention can be of any class (*e.g.* IgG, IgE, IgM, IgD and IgA) or subclass of immunoglobulin molecule.

Monoclonal antibodies may be prepared by any method known in the art such as the hybridoma technique (Kohler & Milstein, 1975, *Nature*, 256:495-497), the trioma technique, the human B-cell hybridoma technique (Kozbor *et al.*, 1983, *Immunology Today*, 4:72) and the EBV-hybridoma technique (Cole *et al.*, *Monoclonal Antibodies and Cancer Therapy*, 20 pp77-96, Alan R Liss, Inc., 1985).

Antibodies for use in the invention may also be generated using single lymphocyte antibody methods by cloning and expressing immunoglobulin variable region cDNAs generated from single lymphocytes selected for the production of specific antibodies by for example the methods described by Babcock, J. *et al.*, 1996, *Proc. Natl. Acad. Sci. USA* 25 93(15):7843-7848 and in WO92/02551.

Humanized antibodies are antibody molecules from non-human species having one or more complementarity determining regions (CDRs) from the non-human species and a framework region from a human immunoglobulin molecule (see, *e.g.* US 5,585,089).

Chimeric antibodies are those antibodies encoded by immunoglobulin genes that 30 have been genetically engineered so that the light and heavy chain genes are composed of immunoglobulin gene segments belonging to different species. These chimeric antibodies are likely to be less antigenic. Bivalent antibodies may be made by methods known in the art (Milstein *et al.*, 1983, *Nature* 305:537-539; WO 93/08829, Traunecker *et al.*, 1991,

EMBO J. 10:3655-3659). Multi-valent antibodies may comprise multiple specificities or may be monospecific (see for example WO 92/22853).

The antibodies for use in the present invention can also be generated using various phage display methods known in the art and include those disclosed by Brinkman *et al.* (in J. Immunol. Methods, 1995, 182: 41-50), Ames *et al.* (J. Immunol. Methods, 1995, 184:177-186), Kettleborough *et al.* (Eur. J. Immunol. 1994, 24:952-958), Persic *et al.* (Gene, 1997 187 9-18), Burton *et al.* (Advances in Immunology, 1994, 57:191-280) and WO 90/02809; WO 91/10737; WO 92/01047; WO 92/18619; WO 93/11236; WO 95/15982; WO 95/20401; and US 5,698,426; 5,223,409; 5,403,484; 5,580,717; 5,427,908; 5,750,753; 5,821,047; 10 5,571,698; 5,427,908; 5,516,637; 5,780,225; 5,658,727; 5,733,743 and 5,969,108.

Techniques for the production of single chain antibodies, such as those described in US 4,946,778 can also be adapted to produce single chain antibodies to IL-17 or IL-17R polypeptides. Also, transgenic mice, or other organisms, including other mammals, may be used to express humanized antibodies.

If desired an antibody for use in the present invention may be conjugated to an effector molecule. The term effector molecule as used herein includes, for example, antineoplastic agents, drugs, toxins, biologically active proteins, for example enzymes, other antibody or antibody fragments, synthetic or naturally occurring polymers, nucleic acids and fragments thereof e.g. DNA, RNA and fragments thereof, radionuclides, particularly radioiodide, 15 radioisotopes, chelated metals, nanoparticles and reporter groups such as fluorescent compounds or compounds which may be detected by NMR or ESR spectroscopy. In one example, anti-IL-17 or anti IL-17 R antibodies can be conjugated to an effector molecule, such as a cytotoxic agent, a radionuclide or drug moiety to modify a given biological response. For example, the therapeutic agent may be a drug moiety which may be a protein 20 or polypeptide possessing a desired biological activity. Such moieties may include, for example and without limitation, a toxin such as abrin, ricin A, pseudomonas exotoxin, or diphtheria toxin, a protein such as tumour necrosis factor, α -interferon, β -interferon, nerve growth factor, platelet derived growth factor or tissue plasminogen activator, a thrombotic agent or an anti-angiogenic agent, e.g. angiostatin or endostatin, or, a biological response 25 modifier such as a lymphokine, interleukin-1 (IL-1), interleukin-2 (IL-2), interleukin-6 (IL-6), granulocyte macrophage colony stimulating factor (GM-CSF), granulocyte colony 30 stimulating factor (G-CSF), nerve growth factor (NGF) or other growth factor.

In another example the effector molecules may be cytotoxins or cytotoxic agents including any agent that is detrimental to (e.g. kills) cells. Examples include taxol, cytochalasin B, gramicidin D, ethidium bromide, emetine, mitomycin, etoposide, tenoposide, vincristine, vinblastine, colchicin, doxorubicin, daunorubicin, dihydroxy anthracin dione, 5 mitoxantrone, mithramycin, actinomycin D, 1-dehydrotestosterone, glucocorticoids, procaine, tetracaine, lidocaine, propranolol, and puromycin and analogs or homologs thereof. Effector molecules also include, but are not limited to, antimetabolites (e.g. methotrexate, 6-mercaptopurine, 6-thioguanine, cytarabine, 5-fluorouracil decarbazine), alkylating agents (e.g. mechlorethamine, thioepa chlorambucil, melphalan, carmustine (BSNU) and lomustine 10 (CCNU), cyclothosphamide, busulfan, dibromomannitol, streptozotocin, mitomycin C, and cis-dichlorodiamine platinum (II) (DDP) cisplatin), anthracyclines (e.g. daunorubicin (formerly daunomycin) and doxorubicin), antibiotics (e.g. dactinomycin (formerly actinomycin), bleomycin, mithramycin, anthramycin (AMC), calicheamicins or duocarmycins), and anti-mitotic agents (e.g. vincristine and vinblastine).

15 Other effector molecules may include radionuclides such as ¹¹¹In and ⁹⁰Y, Lu¹⁷⁷, Bismuth²¹³, Californium²⁵², Iridium¹⁹² and Tungsten¹⁸⁸/Rhenium¹⁸⁸; or drugs such as but not limited to, alkylphosphocholines, topoisomerase I inhibitors, taxoids and suramin. Techniques for conjugating such effector molecules to antibodies are well known in the art (see, Hellstrom *et al.*, Controlled Drug Delivery, 2nd Ed., Robinson *et al.*, eds., 1987, pp. 20 623-53; Thorpe *et al.*, 1982, Immunol. Rev., 62:119-58 and Dubowchik *et al.*, 1999, Pharmacology and Therapeutics, 83, 67-123). In one example, the antibody or fragment thereof is fused via a covalent bond (e.g. a peptide bond), at optionally the N-terminus or the C-terminus, to an amino acid sequence of another protein (or portion thereof; preferably at least a 10, 20 or 50 amino acid portion of the protein). Preferably the antibody, or fragment 25 thereof, is linked to the other protein at the N-terminus of the constant domain of the antibody. Recombinant DNA procedures may be used to create such fusions, for example as described in WO 86/01533 and EP 0392745.

In another example the effector molecule may increase half-life *in vivo*, and/or enhance the delivery of an antibody across an epithelial barrier to the immune system. 30 In one example antibodies for use in the present invention are attached to poly(ethyleneglycol) (PEG) moieties. In one particular example the antibody is an antibody fragment and the PEG molecules may be attached through any available amino acid side-chain or terminal amino acid functional group located in the antibody fragment, for example

any free amino, imino, thiol, hydroxyl or carboxyl group. Such amino acids may occur naturally in the antibody fragment or may be engineered into the fragment using recombinant DNA methods. See for example US 5,219,996. Multiple sites can be used to attach two or more PEG molecules. Preferably PEG molecules are covalently linked through a thiol group of at least one cysteine residue located in the antibody fragment. Where a thiol group is used as the point of attachment appropriately activated effector molecules, for example thiol selective derivatives such as maleimides and cysteine derivatives may be used.

Preferably, the antibody is a modified Fab' fragment which is PEGylated, *i.e.* has PEG (poly(ethyleneglycol)) covalently attached thereto, *e.g.* according to the method disclosed in EP 0948544 [see also "Poly(ethyleneglycol) Chemistry, Biotechnical and Biomedical Applications", 1992, J. Milton Harris (ed), Plenum Press, New York, "Poly(ethyleneglycol) Chemistry and Biological Applications", 1997, J. Milton Harris and S. Zalipsky (eds), American Chemical Society, Washington DC and "Bioconjugation Protein Coupling Techniques for the Biomedical Sciences", 1998, M. Aslam and A. Dent, Grove Publishers, New York; Chapman, A. 2002, Advanced Drug Delivery Reviews 2002, 54:531-545]. Preferably PEG is attached to a cysteine in the hinge region. In one example, a PEG modified Fab' fragment has a maleimide group covalently linked to a single thiol group in a modified hinge region. A lysine residue may be covalently linked to the maleimide group and to each of the amine groups on the lysine residue may be attached a methoxypoly(ethyleneglycol) polymer having a molecular weight of approximately 20,000 Da. The total molecular weight of the PEG attached to the Fab' fragment may therefore be approximately 40,000 Da.

To identify inhibitors of IL-17 activity a number of different approaches may be taken by those skilled in the art. In one example inhibitors are identified by first identifying agents that interact with IL-17 or IL-17R and subsequently testing those agents to identify those that inhibit IL-17 activity. In one such example the agent is an antibody.

Agents that interact with IL-17 or IL-17R may be identified using any suitable method, for example by using a cell-free or cell-based assay system where the IL-17 or IL-17R polypeptide is contacted with a candidate agent and the ability of the candidate agent to interact with the polypeptide is determined. Preferably, the ability of a candidate agent to interact with a IL-17 or IL-17R polypeptide is compared to a reference range or control. If desired, this assay may be used to screen a plurality (*e.g.* a library) of candidate agents using a plurality of IL-17 or IL-17R polypeptide samples. In one example of a cell free assay, a

first and second sample comprising native or recombinant IL-17 or IL-17R polypeptide are contacted with a candidate agent or a control agent and the ability of the candidate agent to interact with the polypeptide is determined by comparing the difference in interaction between the candidate agent and control agent. Preferably, the polypeptide is first immobilized, by, for example, contacting the polypeptide with an immobilized antibody which specifically recognizes and binds it, or by contacting a purified preparation of polypeptide with a surface designed to bind proteins. The polypeptide may be partially or completely purified (e.g. partially or completely free of other polypeptides) or part of a cell lysate. Further, the polypeptide may be a fusion protein comprising the IL-17 or IL-17R polypeptide or a biologically active portion thereof and a domain such as glutathione-S-transferase. Alternatively, the polypeptide can be biotinylated using techniques well known to those of skill in the art (e.g. biotinylation kit, Pierce Chemicals; Rockford, IL). The ability of the candidate agent to interact with the polypeptide can be determined by methods known to those of skill in the art for example, ELISA, BIACore™, Flow cytometry or fluorescent microvolume assay technology (FMAT). In another example where a cell-based assay is used, a population of cells expressing IL-17 or IL-17 R is contacted with a candidate agent and the ability of the candidate agent to interact with the polypeptide is determined. Preferably, the ability of a candidate agent to interact with IL-17 or IL-17 R is compared to a reference range or control. The cell, for example, can be of eukaryotic origin (e.g. yeast or mammalian) and can express the IL-17 or IL-17 R polypeptide endogenously or be genetically engineered to express the polypeptide. In some instances, the IL-17 or IL-17R polypeptide or the candidate agent is labelled, for example with a radioactive label (such as ³²P, ³⁵S or ¹²⁵I) or a fluorescent label (such as fluorescein isothiocyanate, rhodamine, phycoerythrin, phycocyanin, allophycocyanin, o-phthaldehyde or fluorescamine) to enable detection of an interaction between a polypeptide and a candidate agent. Alternative methods such as ELISA, flow cytometry and FMAT may also be used.

Agents which inhibit IL-17 activity may be identified by any suitable method, for example by:

- (i) comparing the activity of IL-17 or IL-17 R in the presence of a candidate agent with the activity of said polypeptide in the absence of the candidate agent or in the presence of a control agent; and
- (ii) determining whether the candidate agent inhibits activity of IL-17 or its receptor.

Such assays can be used to screen candidate agents, in clinical monitoring or in drug development.

In one example a cell-based assay system is used to identify agents capable of inhibiting the activity of IL-17. In one particular example the assay used to identify inhibitors of IL-17 activity is the standard IL-6 release assay from fibroblasts (Yao *et al.*, 5 1995, Journal of Immunology, 155, 5483-5486). Potential inhibitors are added to the assay and IL-6 release determined by ELISA. Inhibition is therefore measured as a lack of IL-6 release compared to controls.

10 In another example inhibitors of IL-17 may down-regulate the expression of the IL-17 or IL-17R polypeptide, for example antisense inhibitors. Such inhibitors may be identified by any method known in the art. In one example such inhibitors are identified in a cell-based assay system. Accordingly, a population of cells expressing a IL-17 or IL-17R polypeptide or nucleic acid are contacted with a candidate agent and the ability of the 15 candidate agent to alter expression of the IL-17 or IL-17R polypeptide or nucleic acid is determined by comparison to a reference range or control. In one example, populations of cells expressing a IL-17 or IL-17R polypeptide are contacted with a candidate agent or a control agent and the ability of the candidate agent to alter the expression of the IL-17 or IL-17R polypeptides or nucleic acids is determined by comparing the difference in the level of 20 expression of the IL-17 or IL-17R polypeptides or nucleic acids between the treated and control populations of cells. If desired, this assay may be used to screen a plurality (e.g. a library) of candidate agents. The cell, for example, can be of eukaryotic origin (e.g. yeast or mammalian) and can express an IL-17 or IL-17R polypeptide endogenously or be genetically engineered to express a IL-17 or IL-17R polypeptide. The ability of the candidate agents to 25 alter the expression of a said polypeptides or nucleic acids can be determined by methods known to those of skill in the art, for example and without limitation, by flow cytometry, radiolabelling, a scintillation assay, immunoprecipitation, Western blot analysis, Northern blot analysis or RT-PCR.

Agents that inhibit the activity of IL-17 may be identified or further tested, for example 30 to determine therapeutically effective amounts in one or more animal models. Examples of suitable animals include, but are not limited to, mice, rats, rabbits, monkeys, guinea pigs, dogs and cats. Preferably, the animal used represents a model of MS.

In one example where the agent inhibits the expression of IL-17 or IL-17R, a first and second group of mammals are administered with a candidate agent or a control agent and the ability of the candidate agent to inhibit the expression of IL-17 or IL-17R polypeptide or nucleic acid is determined by comparing the difference in the level of expression between the first and second group of mammals. Where desired, the expression levels of the IL-17 or IL-17R polypeptides or nucleic acid in the first and second groups of mammals can be compared to the level of IL-17 or IL-17R polypeptide or nucleic acid in a control group of mammals. The candidate agent or a control agent can be administered by means known in the art (e.g. orally, rectally or parenterally such as intraperitoneally or intravenously).

Changes in the expression of a polypeptide or nucleic acid can be assessed by the methods outlined above.

In another example, the inhibition of IL-17 activity can be determined by monitoring an amelioration or improvement in disease symptoms, a delayed onset or slow progression of the disease, for example but without limitation, a reduction in paralysis. Techniques known to physicians familiar with MS can be used to determine whether a candidate agent has altered one or more symptoms associated with the disease.

A number of different models of MS are known in the art ('t Hart and Amor 2003, Current Opinion in Neurology 16:375-83). In particular, experimental autoimmune encephalomyelitis (EAE) in ABH mice is considered to be a relevant model for MS in humans (Baker et al., 1990. Journal of Neuroimmunology, 28:261-270). Both acute and relapsing-remitting models have been developed.

As discussed herein, inhibitors of IL-17 activity can be used in the treatment and/or prophylaxis of MS. For such use the agents will generally be administered in the form of a pharmaceutical composition.

Also provided is a pharmaceutical composition comprising an inhibitor of IL-17 activity and a pharmaceutically acceptable carrier.

The term 'treatment' includes either therapeutic or prophylactic therapy. When a reference is made herein to a method of treating or preventing a disease or condition using a particular inhibitor or combination of inhibitors, it is to be understood that such a reference is intended to include the use of that inhibitor or combination of inhibitors for the manufacture of a medicament for the treatment and/or prophylaxis of MS.

The composition will usually be supplied as part of a sterile, pharmaceutical composition that will normally include a pharmaceutically acceptable carrier. This composition

may be in any suitable form (depending upon the desired method of administering it to a patient).

The inhibitors of use in the invention are preferably administered to a subject by a variety of other routes such as orally, transdermally, subcutaneously, intranasally, 5 intravenously, intramuscularly, intrathecally and intracerebroventricularly. The most suitable route for administration in any given case will depend on the particular inhibitor, the subject, and the nature and severity of the disease and the physical condition of the subject.

The inhibitors of use in the invention may be administered in combination, e.g. simultaneously, sequentially or separately, with one or more other therapeutically active 10 compounds, which may be for example other anti-MS therapies or anti-cancer therapies.

Pharmaceutical compositions may be conveniently presented in unit dose forms containing a predetermined amount of an active agent of the invention per dose. Such a unit 15 may contain for example but without limitation, 750mg/kg to 0.1mg/kg depending on the condition being treated, the route of administration and the age, weight and condition of the subject.

Pharmaceutically acceptable carriers for use in the invention may take a wide variety of forms depending, e.g. on the route of administration.

Compositions for oral administration may be liquid or solid. Oral liquid preparations may be in the form of, for example, aqueous or oily suspensions, solutions, emulsions, 20 syrups or elixirs, or may be presented as a dry product for reconstitution with water or other suitable vehicle before use. Oral liquid preparations may contain suspending agents as known in the art.

In the case of oral solid preparations such as powders, capsules and tablets, carriers such as starches, sugars, microcrystalline cellulose, granulating agents, lubricants, binders, 25 disintegrating agents, and the like may be included. Because of their ease of administration, ~~tablets and capsules represent the most advantageous oral dosage unit form in which case solid pharmaceutical carriers are generally employed.~~ In addition to the common dosage forms set out above, active agents of the invention may also be administered by controlled release means and/or delivery devices. Tablets and capsules may comprise conventional carriers or excipients such as binding agents for example, syrup, acacia, gelatin, sorbitol, tragacanth, or polyvinylpyrrolidone; fillers, for example lactose, sugar, maize-starch, calcium phosphate, sorbitol or glycine; tabletting lubricants, for example magnesium stearate, 30 talc, polyethylene glycol or silica; disintegrants, for example potato starch; or acceptable

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wetting agents such as sodium lauryl sulphate. The tablets may be coated by standard aqueous or non-aqueous techniques according to methods well known in normal pharmaceutical practice.

Pharmaceutical compositions of the present invention suitable for oral administration
5 may be presented as discrete units such as capsules, cachets or tablets, each containing a predetermined amount of the active agent, as a powder or granules, or as a solution or a suspension in an aqueous liquid, a non-aqueous liquid, an oil-in-water emulsion or a water-in-oil liquid emulsion. Such compositions may be prepared by any of the methods of
10 pharmacy but all methods include the step of bringing into association the active agent with the carrier, which constitutes one or more necessary ingredients. In general, the compositions are prepared by uniformly and intimately admixing the active agent with liquid carriers or finely divided solid carriers or both, and then, if necessary, shaping the product into the desired presentation. For example, a tablet may be prepared by compression or moulding, optionally with one or more accessory ingredients.

15 Pharmaceutical compositions suitable for parenteral administration may be prepared as solutions or suspensions of the active agents of the invention in water suitably mixed with a surfactant such as hydroxypropylcellulose. Dispersions can also be prepared in glycerol, liquid polyethylene glycols, and mixtures thereof in oils. Under ordinary conditions of storage and use, these preparations contain a preservative to prevent the growth of
20 microorganisms.

The pharmaceutical forms suitable for injectable use include aqueous or non-aqueous sterile injection solutions which may contain anti-oxidants, buffers, bacteriostats and solutes which render the composition isotonic with the blood of the intended recipient, and aqueous and non-aqueous sterile suspensions which may include suspending agents and thickening
25 agents. Extemporaneous injection solutions, dispersions and suspensions may be prepared from sterile powders, granules and tablets.

Pharmaceutical compositions can be administered with medical devices known in the art. For example, in a preferred embodiment, a pharmaceutical composition of the invention can be administered with a needleless hypodermic injection device, such as the
30 devices disclosed in US 5,399,163; 5,383,851; 5,312,335; 5,064,413; 4,941,880; 4,790,824; or 4,596,556. Examples of well-known implants and modules useful in the present invention include: US 4,487,603, which discloses an implantable micro-infusion pump for dispensing medication at a controlled rate; US 4,486,194, which discloses a therapeutic device for

administering medicaments through the skin; US 4,447,233, which discloses a medication infusion pump for delivering medication at a precise infusion rate; US 4,447,224, which discloses a variable flow implantable infusion apparatus for continuous drug delivery; US 4,439,196, which discloses an osmotic drug delivery system having multi-chamber compartments; and US 4,475,196, which discloses an osmotic drug delivery system. Many other such implants, delivery systems, and modules are known to those skilled in the art.

Pharmaceutical compositions adapted for topical administration may be formulated as ointments, creams, suspensions, lotions, powders, solutions, pastes, gels, impregnated dressings, sprays, aerosols or oils, transdermal devices, dusting powders, and the like. These compositions may be prepared via conventional methods containing the active agent. Thus, they may also comprise compatible conventional carriers and additives, such as preservatives, solvents to assist drug penetration, emollients in creams or ointments and ethanol or oleyl alcohol for lotions. Such carriers may be present as from about 1% up to about 98% of the composition. More usually they will form up to about 80% of the composition. As an illustration only, a cream or ointment is prepared by mixing sufficient quantities of hydrophilic material and water, containing from about 5-10% by weight of the compound, in sufficient quantities to produce a cream or ointment having the desired consistency.

Pharmaceutical compositions adapted for transdermal administration may be presented as discrete patches intended to remain in intimate contact with the epidermis of the recipient for a prolonged period of time. For example, the active agent may be delivered from the patch by iontophoresis.

For applications to external tissues, for example the mouth and skin, the compositions are preferably applied as a topical ointment or cream. When formulated in an ointment, the active agent may be employed with either a paraffinic or a water-miscible ointment base. Alternatively, the active agent may be formulated in a cream with an oil-in-water cream base or a water-in-oil base.

Pharmaceutical compositions adapted for topical administration in the mouth include lozenges, pastilles and mouth washes.

Pharmaceutical compositions adapted for topical administration to the eye include eye drops wherein the active agent is dissolved or suspended in a suitable carrier, especially an aqueous solvent. They also include topical ointments or creams as above.

Pharmaceutical compositions suitable for rectal administration wherein the carrier is a solid are most preferably presented as unit dose suppositories. Suitable carriers include cocoa butter or other glyceride or materials commonly used in the art, and the suppositories may be conveniently formed by admixture of the combination with the softened or melted carrier(s) followed by chilling and shaping moulds. They may also be administered as enemas.

The dosage to be administered of an inhibitor of IL-17 activity will vary according to the particular inhibitor, the type of MS, the subject, and the nature and severity of the disease and the physical condition of the subject, and the selected route of administration; the appropriate dosage can be readily determined by a person skilled in the art. For the treatment and/or prophylaxis of MS in humans and animals pharmaceutical compositions comprising antibodies can be administered to patients (e.g., human subjects) at therapeutically or prophylactically effective dosages (e.g. dosages which result in inhibition of MS and/or relief of MS symptoms) using any suitable route of administration, such as injection and other routes of administration known in the art for clinical products, such as antibody-based clinical products.

The compositions may contain from 0.1% by weight, preferably from 10-60%, or more, by weight, of the inhibitor of the invention, depending on the method of administration.

It will be recognized by one of skill in the art that the optimal quantity and spacing of individual dosages of an inhibitor of the invention will be determined by the nature and extent of the condition being treated, the form, route and site of administration, and the age and condition of the particular subject being treated, and that a physician will ultimately determine appropriate dosages to be used. This dosage may be repeated as often as appropriate. If side effects develop the amount and/or frequency of the dosage can be altered or reduced, in accordance with normal clinical practice.

In another example, where the inhibitor is a nucleic acid this may be administered via gene therapy (see for example Hoshida, T. *et al.*, 2002, Pancreas, 25:111-121; Ikuno, Y. 2002, Invest. Ophthalmol. Vis. Sci. 2002 43:2406-2411; Bolland, C., 2002, Blood 99:3179-3187; Lee E., 2001, Mol. Med. 7:773-782). Gene therapy refers to administration to a subject of an expressed or expressible nucleic acid. In one example this is either the IL-17 or the IL-17R nucleic acid. Any of the methods for gene therapy available in the art can be used according to the present invention.

Delivery of the therapeutic nucleic acid into a patient can be direct *in vivo* gene therapy (*i.e.* the patient is directly exposed to the nucleic acid or nucleic acid-containing vector) or indirect *ex vivo* gene therapy (*i.e.* cells are first transformed with the nucleic acid *in vitro* and then transplanted into the patient).

5 For example for *in vivo* gene therapy, an expression vector containing the IL-17 or IL-17R nucleic acid may be administered in such a manner that it becomes intracellular, *i.e.* by infection using a defective or attenuated retroviral or other viral vectors as described, for example, in US 4,980,286 or by Robbins *et al.*, 1998, Pharmacol. Ther. 80:35-47.

10 The various retroviral vectors that are known in the art are such as those described in Miller *et al.* (1993, Meth. Enzymol. 217:581-599) which have been modified to delete those retroviral sequences which are not required for packaging of the viral genome and subsequent integration into host cell DNA. Also adenoviral vectors can be used which are advantageous due to their ability to infect non-dividing cells and such high-capacity adenoviral vectors are described in Kochanek (1999, Human Gene Therapy, 10:2451-2459).
15 Chimeric viral vectors that can be used are those described by Reynolds *et al.* (1999, Molecular Medicine Today, 1:25 -31). Hybrid vectors can also be used and are described by Jacoby *et al.* (1997, Gene Therapy, 4:1282-1283).

20 Direct injection of naked DNA or through the use of microparticle bombardment (*e.g.* Gene Gun®; Biostatic, Dupont) or by coating it with lipids can also be used in gene therapy. Cell-surface receptors/transfected compounds or through encapsulation in liposomes, microparticles or microcapsules or by administering the nucleic acid in linkage to a peptide which is known to enter the nucleus or by administering it in linkage to a ligand predisposed to receptor-mediated endocytosis (See Wu & Wu, 1987, J. Biol. Chem., 262:4429-4432) can be used to target cell types which specifically express the receptors of interest.

25 In *ex vivo* gene therapy, a gene is transferred into cells *in vitro* using tissue culture and the cells are delivered to the patient by various methods such as injecting subcutaneously, application of the cells into a skin graft and the ~~intravenous~~ injection of recombinant blood cells such as haematopoietic stem or progenitor cells.

30 Cells into which a IL-17 or IL-17R nucleic acid can be introduced for the purposes of gene therapy include, for example, epithelial cells, endothelial cells, keratinocytes, fibroblasts, muscle cells, hepatocytes and blood cells. The blood cells that can be used include, for example, T-lymphocytes, B-lymphocytes, monocytes, macrophages, neutrophils,

eosinophils, megakaryocytes, granulocytes, haematopoietic cells or progenitor cells, and the like.

In a one aspect, the pharmaceutical composition of the present invention comprises an IL-17 or IL-17R nucleic acid, said nucleic acid being part of an expression vector that expresses an IL-17 or IL-17R polypeptide or chimeric protein thereof in a suitable host. In particular, such a nucleic acid has a promoter operably linked to the polypeptide coding region, said promoter being inducible or constitutive (and, optionally, tissue-specific).

The invention will now be described with reference to the following examples, which are merely illustrative and should not in any way be construed as limiting the scope of the present invention.

Figures

Figure 1: Effect of anti-IL17 on clinical disease when dosed from day -1 through the acute phase (black arrowheads, days -1, 6, 13, 20). Average clinical score (+/- sd) plotted against day of disease induction (a) and average change in weight from day 0 (b).

Figure 2. Analysis of the acute phase of disease following dosing of anti-IL-17 through the acute phase.

Figure 3. Analysis of the relapse phase of disease following dosing of anti-IL-17 through the acute phase.

Figure 4 Effect of anti-IL17 on clinical disease when dosed through the relapse phase (days 28, 35, 42 and 49, black arrowheads). Average clinical score (+/- sd) versus day of disease induction (a) and average change in weight from day 0 (b).

Figure 5. Analysis of the acute phase of disease following dosing of anti-IL-17 through the relapse phase.

Figure 6. Analysis of the relapse phase of disease following dosing of anti-IL-17 through the relapse phase.

Examples

Example 1. Isolation of an anti-IL-17 antibody

Rabbits were immunised three times with human IL-17 and then twice with mouse IL-17. Using a haemolytic plaque assay with biotinylated sheep red blood cells coated with murine IL-17 via streptavidin, 9 antibody genes were isolated using the methods described by Babcock *et al.*, 1996, Proc.Natl.Acad.Sci, 93, 7843-7848 and in WO92/02551. The

antibody genes were expressed in CHO cells and the recombinant antibodies screened for their ability to neutralise murine IL-17 in a bioassay using mouse 3T3-NIH cells (Yao *et al.*, 1995, *Immunity*, 3:811-821). All the antibodies in the panel neutralised murine IL-17 in this assay and one antibody, m170013 (Ab#13) was selected for *in vivo* testing. For testing the efficacy of the antibody in EAE, a chimeric IgG was produced using the rabbit variable region from antibody m170013 and mouse constant regions.

Example 2. Effect of anti-IL-17 antibody on the symptoms of EAE

The MS model, experimental autoimmune encephalomyelitis (EAE), was used essentially as described by Baker *et al.*, 1990. *Journal of Neuroimmunology*, 28:261-270.

Female ABH mice 8-10 weeks of age (Harlan) were immunised with mouse spinal cord homogenate (SCH, 3.33mg/ml) in complete freund's adjuvant by subcutaneous immunisation in either flank (150 μ l/site) on days 0 and 7.

15 i) Dosing over the acute phase

Two groups were dosed with antibody at 10mg/kg , sc on days -1, 6, 13 and 20. One group (n=14) was dosed with anti-mouse IL17 (#13, whole IgG) the other (n=13) with 101.4 (isotype control).

20 ii) Dosing over the relapsing phase

A total of 30 mice were followed through the acute phase of disease and on day 27 analysis of the acute phase of disease was performed to select two groups with similar disease profiles in the acute phase (day of onset, peak disease score, cumulative clinical score and weight loss). Two groups of 12 mice were selected for dosing with antibody at 10mg/kg , sc on days 28, 35, 42 and 49. One group was dosed with anti-mouse IL17 (#13. whole IgG) the other with 101.4 (isotype control).

Weights and clinical scores were recorded daily by an assessor blinded to treatment and terminal EDTA-Plasma collected.

30

Clinical score scale

0	Normal
0.25	Tail dragging

0.5	Partial tail paralysis
1	Complete tail paralysis
2	Incomplete hind limb paralysis
3	Complete hind paralysis / incontinence
5	Front limb paralysis / loss of righting reflex

Statistics

Pairwise comparisons of clinical scores and day of onset were performed using Mann-Whitney U test, analysis of incidence was performed with Fishers exact test, analysis of maximum weight loss was performed using Students' T test.

Results

i) Dosing during acute phase: A significant delay in the onset of the acute phase and a reduced severity and incidence of first relapse was observed (Figures 1, 2 and 3). Figure 2 shows that anti-IL-17 dosed through the acute phase had no effect on the incidence of disease in the acute phase (IL-17, 13/14 with disease vs 13/13 for isotype control, 101.4). The only statistically significant effect was a delay in the onset of the acute phase of disease Figure 2 a, p=0.0039, Mann-Whitney U test. No effects were seen on weight loss (b), maximum clinical score (c) or cumulative clinical score (d) in the acute phase. Figure 3 shows that anti-mouse IL-17 dosed through the acute phase caused a significant reduction in the incidence of the relapse phase of disease (IL-17, 6/14 with disease vs 11/11 for isotype control, 101.4, p=0.0029, Fishers exact test). There was no statistically significant delay in the onset of the relapse phase of disease for those animals which entered relapse (a). A significant reduction in weight loss (b, p=0.0001, Student's T test), maximum clinical score (c, p=0.0028, Mann-Whitney U test)) and cumulative clinical score (d, p=0.0001, Mann-Whitney U test) were observed during the relapse phase.

ii) Dosing through the relapsing phase: A reduced incidence, delayed onset and reduced severity of the relapse phase was observed (see figs 4, 5 and 6). Figure 5 shows that the dose groups selected to have a similar acute phase profile, showed no significant differences in any of the parameters analysed. Figure 6 shows that anti-mouse IL-17 dosed through the relapse phase caused a significant reduction in the incidence of the relapse phase of disease (IL-17, 5/12 with disease vs 12/12 for isotype control, 101.4, p=0.0046, Fishers exact test). There was also a statistically significant delay in the onset of the relapse phase of disease for

those animals which entered relapse (a, $p=0.0061$). A significant reduction in weight loss (b, $p<0.0001$, Student's T test), maximum clinical score (c, $p=0.0011$, Mann-Whitney U test)) and cumulative clinical score (d, $p=0.0023$, Mann-Whitney U test) were also observed during the relapse phase.

5

Summary

Anti-IL17 antibody was dosed in separate experiments over the acute phase of disease (prophylactic dosing) and over the relapse phase (therapeutic dosing). Effects were most pronounced on relapse with a significant reduction in the incidence and severity of the
10 relapse phase for both dosing regimes.

Figure 1

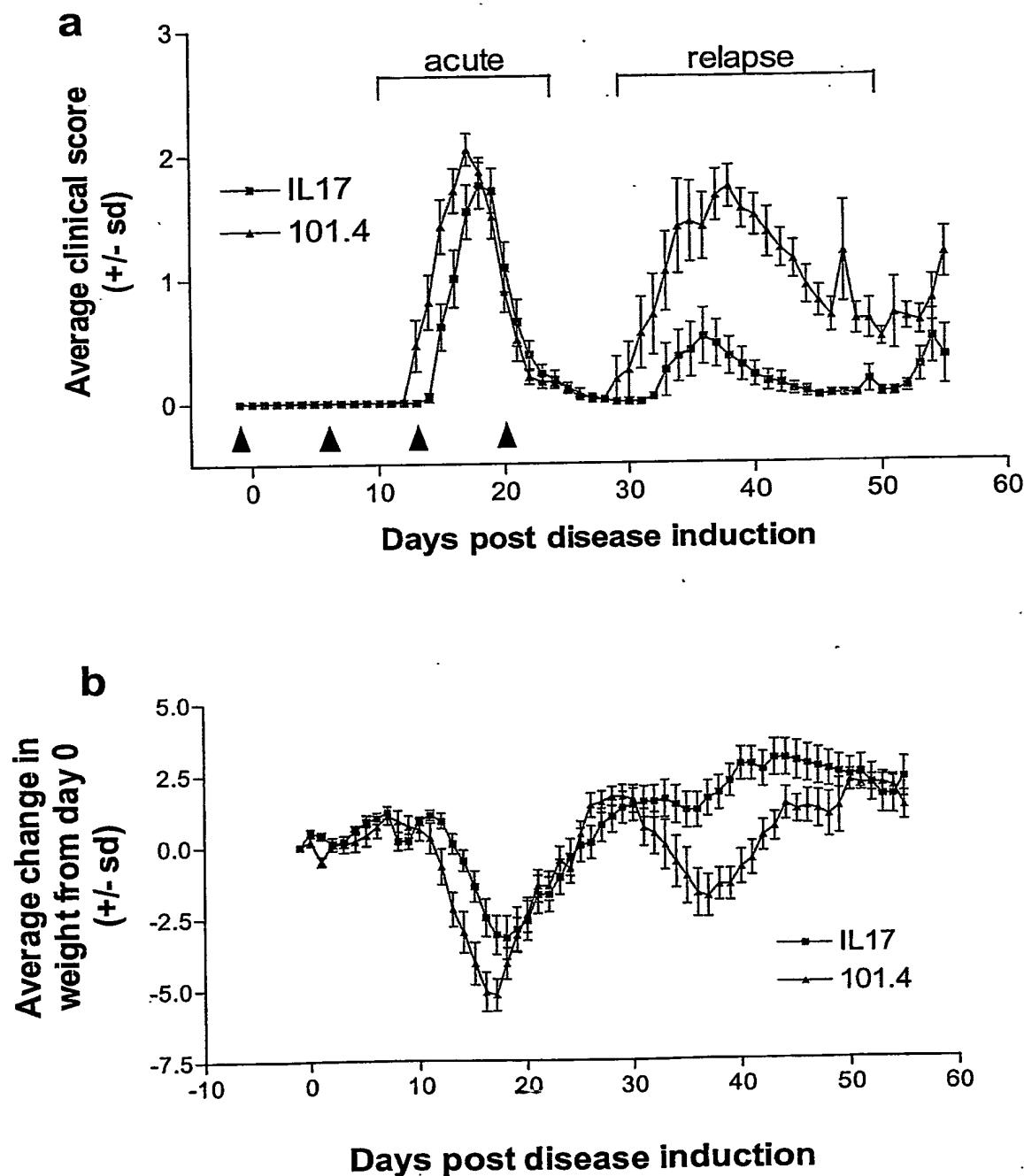


Figure 2

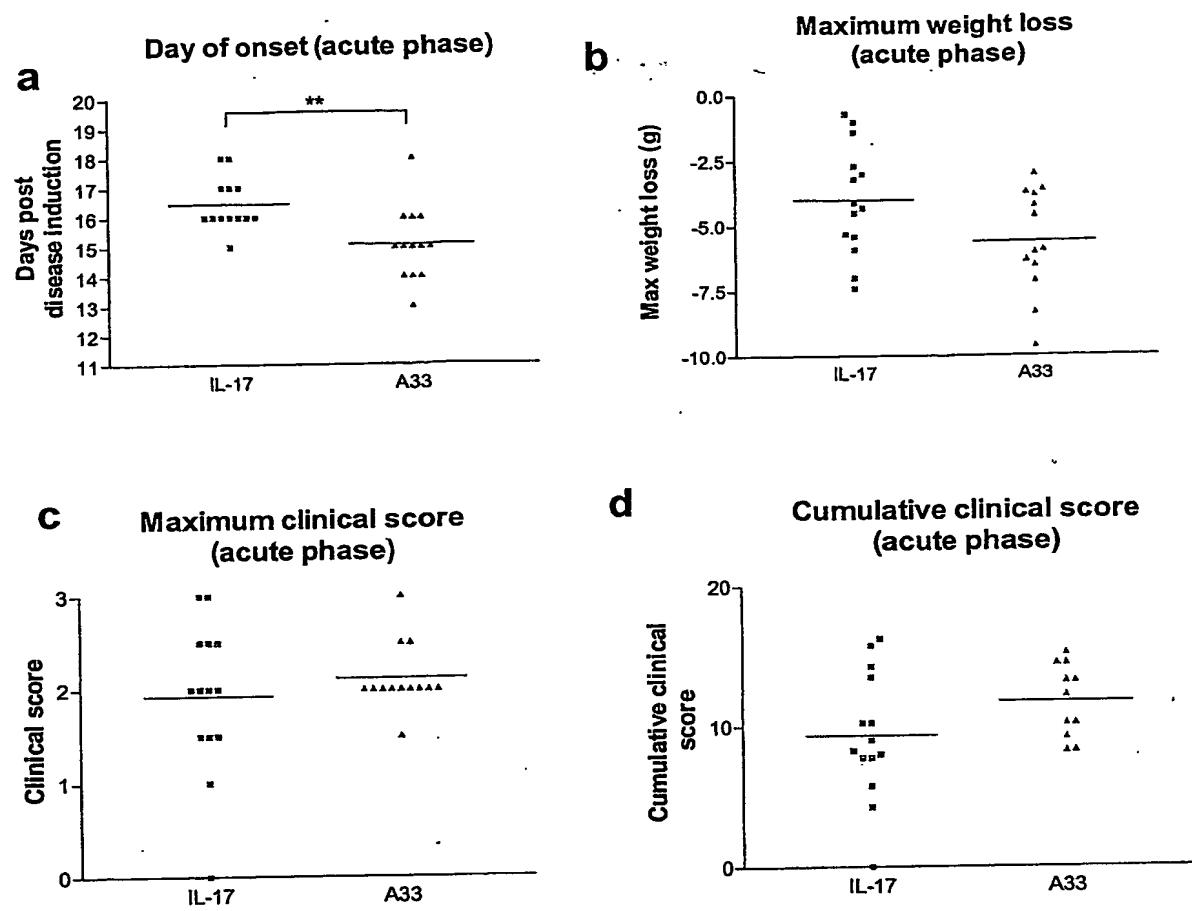


Figure 3

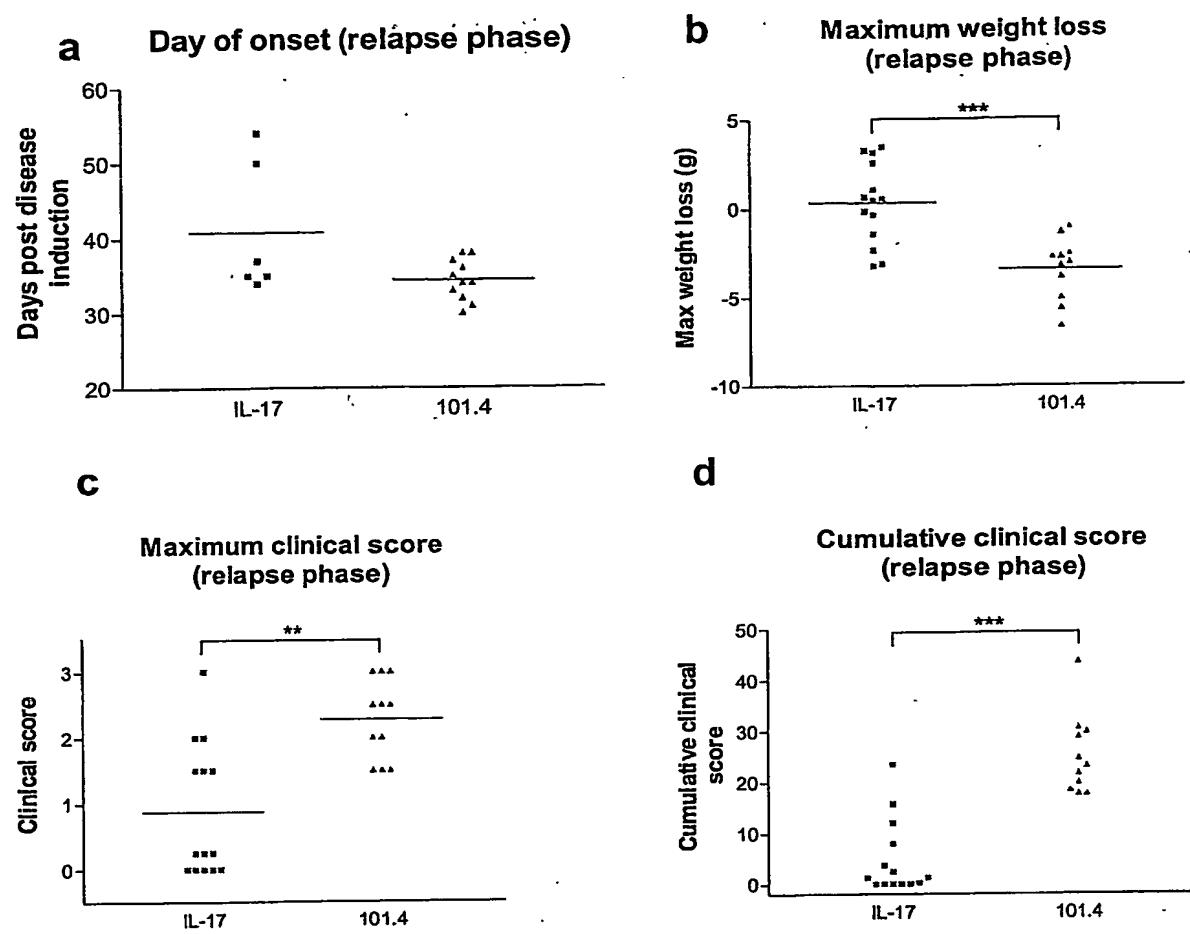


Figure 4

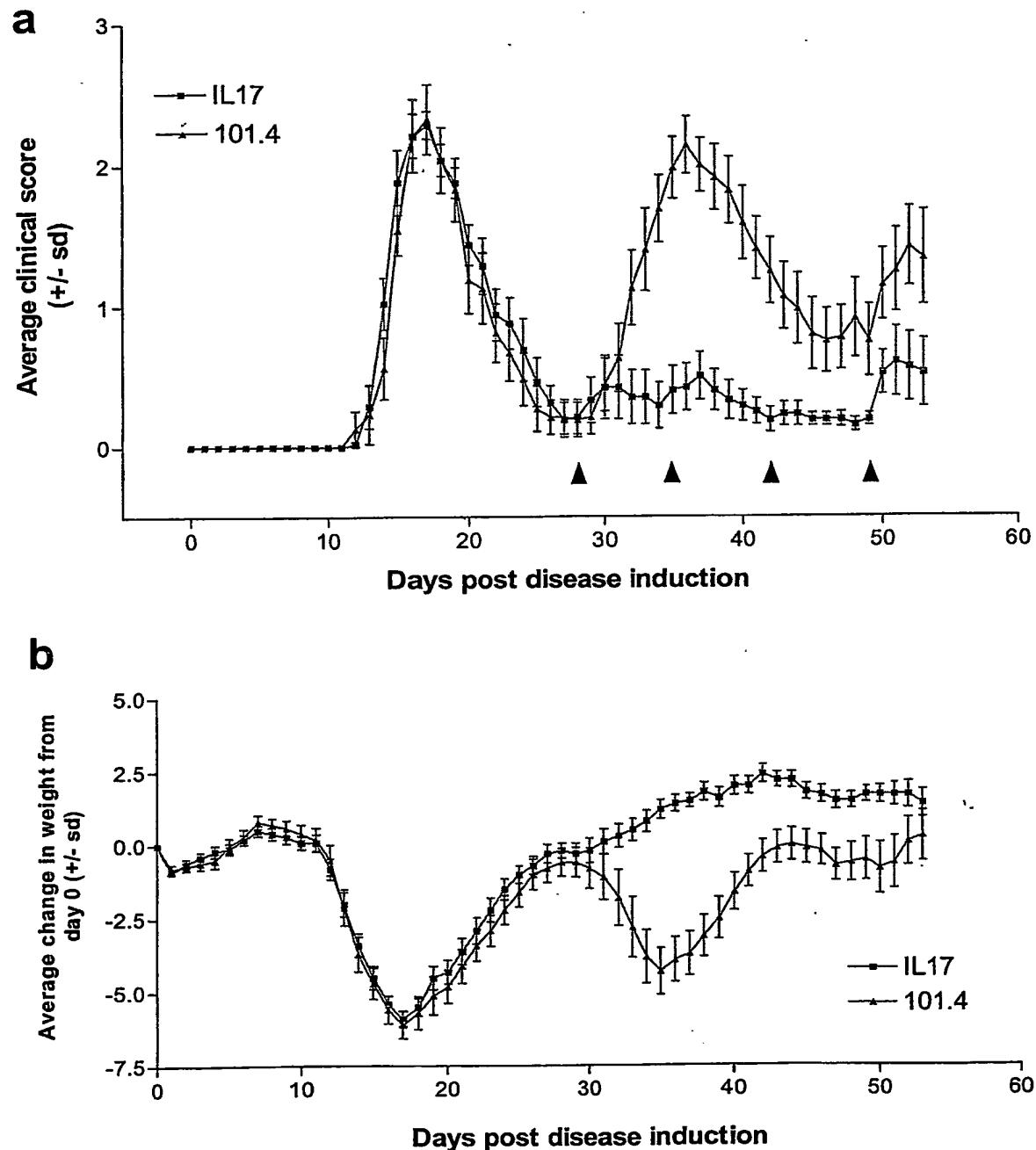


Figure 5

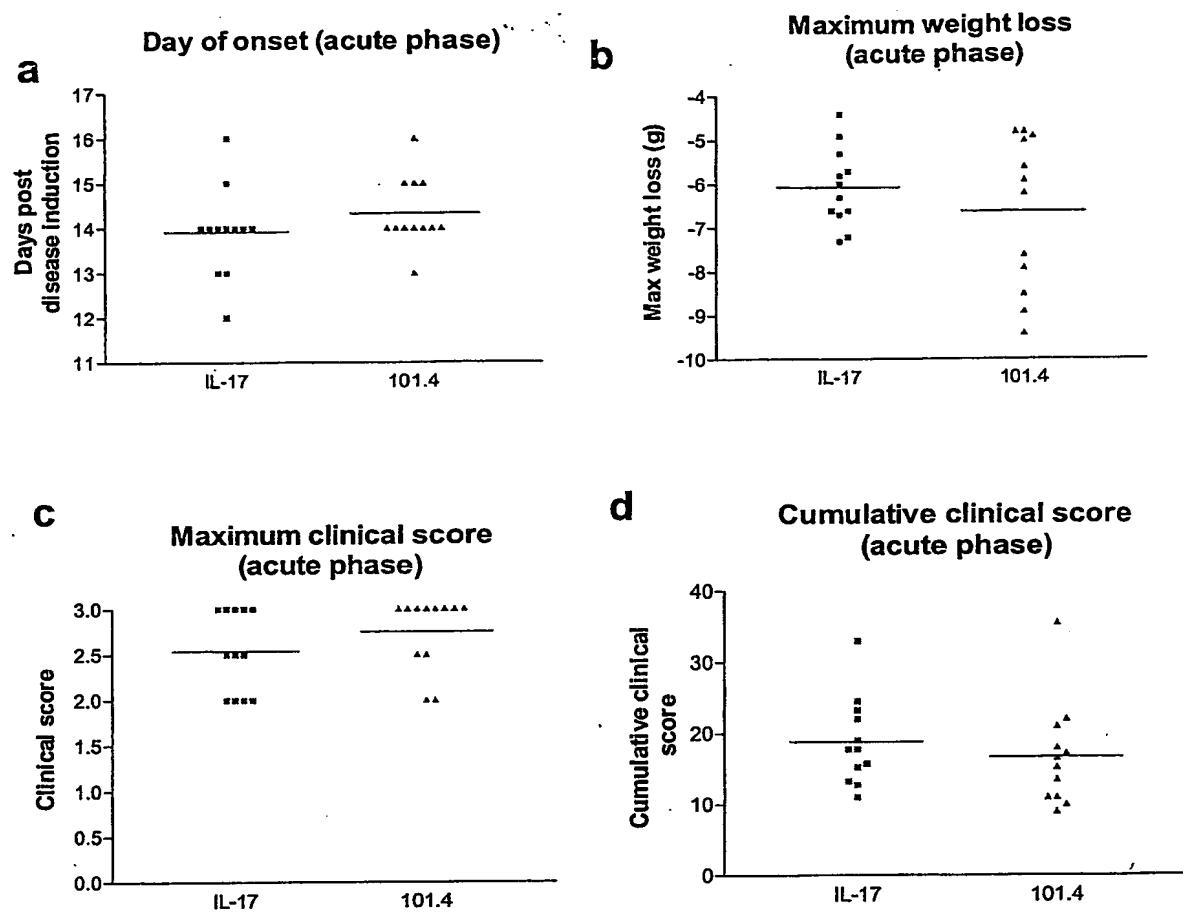
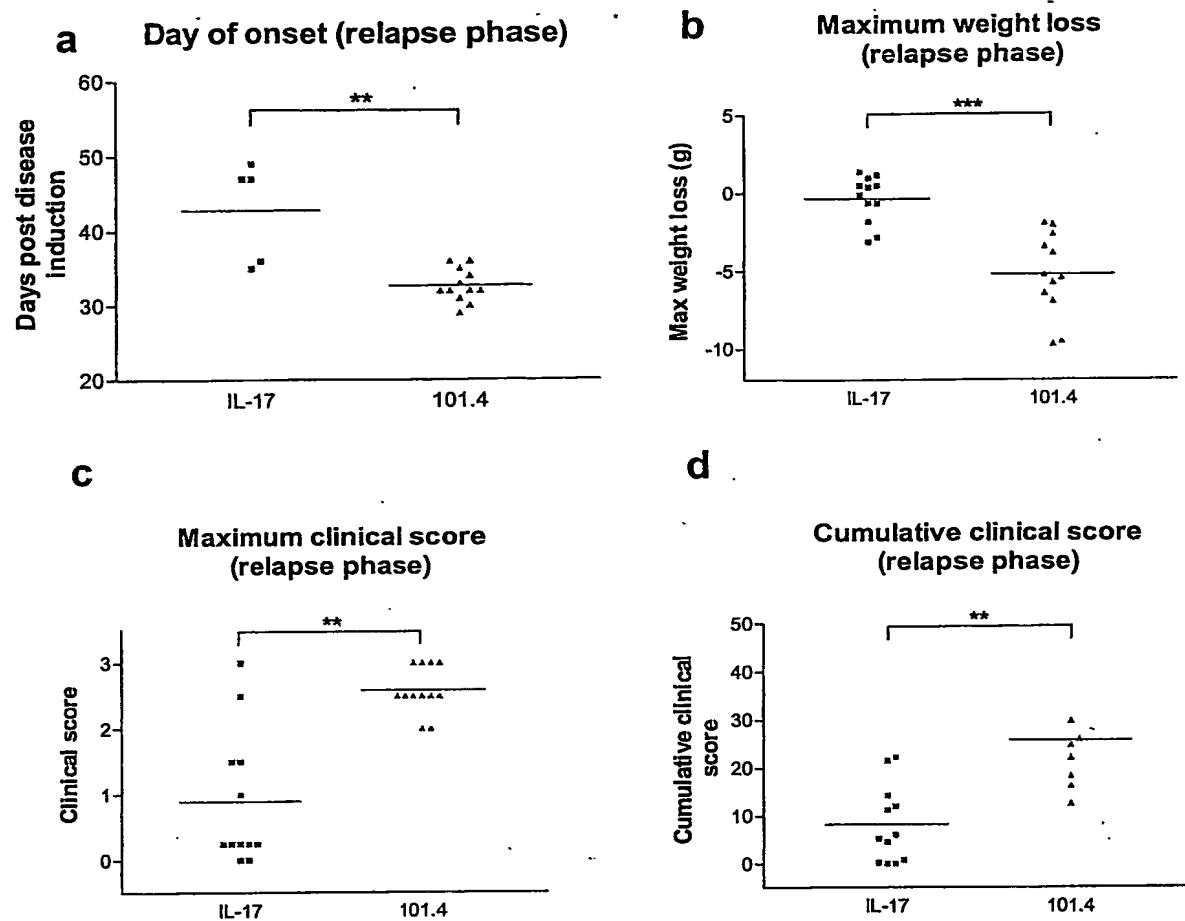


Figure 6



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